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Superconductivity Technology Center

Researchers at the Superconductivity Technology Center are collaborating with an alliance of industry and research organizations that plans to develop and commercialize future-generation, high-temperature superconducting wires. Los Alamos—whose researchers last year developed a revolutionary, flexible, high-temperature superconducting tape that delivers world-record current levels—has signed agreements with American Superconductor Corporation and the Electric Power Research Institute and will join other research organizations in a superconducting wire-development alliance.

These agreements will permit the Los Alamos Superconductivity Technology Center to work with other organizations to refine technologies that will allow the United States to advance its lead in superconductivity. Alliance members will look at ways to enable large-scale manufacturing of huge lengths of superconducting wires, including wires based on the "super tape" developed last year.

This super tape has a current density of more than 1 million amperes per square centimeter at liquid nitrogen temperature—a current density much greater than any other flexible high-temperature superconducting tape yet developed. To make the tape, researchers deposited a layer of cubic zirconia on top of a flexible strip of nickel. The process, called ion-beam assisted deposition, aligns the cubic zirconia crystals at a specific angle. A superconducting ceramic, yttrium-barium-copper-oxide, is deposited by pulsed laser on top of the cubic zirconia layer. The precise orientation of the layers obtained by this deposition process is necessary for superconducting materials if they are to allow high current to flow through them.

The wire development alliance includes Los Alamos, American Superconductor, Electric Power Research Institute, University of Wisconsin Applied Superconductivity Center, Inco Alloys International, Stanford University, and Lawrence Berkeley National Laboratory.

photo by Fred Rick

Paul Arendt (left) and Steve Foltyn (right), researchers at the Superconductivity Technology Center, collaborate with Xin Di Wu on the flexible, high-current, high-temperature superconducting tape they developed. In the background is the ion-beam assisted deposition machine that deposits one of two layers of superconducting material onto the thin, flexible tape.

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Collaborations with U.S. industry involve large and small organizations and a variety of research topics

Los Alamos scientists working in the field of high-temperature superconductivity have joined with industry to identify applications of this important technology in innovative new products. Coordinated through the Superconductivity Technology Center (STC), these industrial collaborations have blazed a path for transferring technologies developed at Los Alamos to the private sector for commercialization.

Since 1992 the Superconductivity Technology Center has participated in more than twenty collaborative agreements with American industry with a total value exceeding $15 million. Both large companies and small organizations are taking advantage of this unique opportunity. University collaborators have also joined in the superconductivity projects, and the Center is currently collaborating with the National High Magnetic Field Laboratory

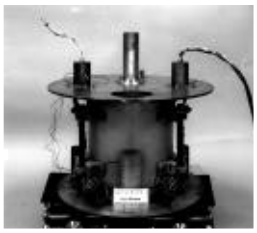
to use high-temperature supconducting materials to make ultrahigh field magnets capable of generating >25 tesla. Industries currently involved in collaborative projects with the STC include:

- **American Superconductor Corporation** (Westborough, MA): To research, develop, and produce high-temperature superconducting wires for electric energy applications.
- **BOC Group** (Murray Hill, NJ): To study processes to produce high purity gases based on high-temperature superconducting technology.
- **Electric Power Research Institute** (Palo Alto, CA): To research, develop, and produce high-temperature superconducting wires for electric energy applications.
- **Eriez Magnetics** (Erie, PA): To develop magnetic separators to separate Kaolin clay for paper manufacture.
- **Eurus Technologies** (Riverhead, NY): To develop high-temperature superconductive current leads and superconducting solder.
- **Lockheed Martin Corporation** (San Diego, CA): To develop high-temperature superconducting coils for electric power applications.
- **Oxford Instruments** (Carteret, NJ): To produce ceramic superconducting wires to use in commercial high-strength magnets, which may lead to powerful new research tools.

The Los Alamos Industrial Partnership Office (505/665-9090) acts as a liaison between the Laboratory and industry. This office will respond to inquiries from businesses interested in pursuing information about collaborations involving superconductivity technology programs.

Irradiation-induced fission improves superconducting properties

By exposing commercially prepared bismuth-based (BiSrCaCuO) superconducting tapes to high energy proton radiation (0.8 GeV), Los Alamos researchers have been able to greatly improve the transport critical current densities at liquid nitrogen temperature. This process stabilizes currents at higher temperatures by introducing special “columnar” defect structures in the superconducting material. These defects, shown in the micrograph, can be created in situ and distributed uniformly throughout the superconductor. A natural extension of this technique would be to irradiate large quantities of material or even whole devices. To this end, the Los Alamos team is working with American Superconductor Corporation on the possibility of irradiating devices such as solenoids as the final step in manufacturing.



Lab researchers demonstrate magnetic separation system

Another exciting application of superconductivity is magnetic separation. The magnetic separator shown here uses a high-temperature superconducting coil to create an intense magnetic field and demonstrates the feasibility of small, compact, cost-effective magnetic separation systems for commercial applications. This highly efficient system could be used in a variety of waste remediation efforts for environmental cleanup, in the mining industry for ore processing, and to purify clay to produce high-quality paper.

Calorimeter studies provide data for evaluating new cable designs.

One of the greatest challenges to the electric power industry is how to minimize the power losses caused by resistance in the wire as electricity is transmitted across normal power lines. A recent alliance between Los Alamos, Electric Power Research Institute, Pirelli Cavi SpA, and American Superconductor will study prototype cable designs that use high-temperature superconducting wire in an attempt to lower these power losses. Using a calorimeter developed at Los Alamos (pictured at left), scientists are testing one-meter sections of these novel superconducting cables to determine their success in reducing resistance and thus lowering power loss.

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